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pitch as well as protecting it from injury or decay.

After describing the anatomy of the vocal organs, the author passes to a consideration of the uses of the laryngoscope. Although this instrument is of inestimable value in the recognition and treatment of disease, it has, nevertheless, added very little to the knowledge of the physiology of the larynx. This is accounted for by the greater amount of skill required for the examination of the larynx in the act of singing than for ordinary medical purposes, and also by the fact that but few throats are sufficiently tolerant to permit of such a prolonged examination as is necessary to obtain results of much value.

The development of the voice receives considerable attention in the author's methods. Many children can be taught to sing little airs when they are between three and four years old. From the age of six until that of fourteen or sixteen the voice undergoes but little change except in the way of gaining power. At this time a marked change occurs, more noticeable in boys than girls, that is, 'the changing of the voice.' This is due to an increase in the size of the larynx in all its dimensions, enlargement and consolidation of the cartilages, and an increase in length and thickness of the vocal cords.

In speaking of the training of the singing voice, Dr. Mackenzie recommends vocal gymnastics and a development of the breathing capacity, by walking, hill-climbing, running, fencing, and swimming, and in a chapter devoted to the care of the formed voice directs the avoidance of strain and complete inaction of the vocal organs when out of order. The influence of the general health upon the voice is very marked. Whatever is good for the singer's general health is *pro tanto* beneficial to his voice. Alcohol and tobacco should not be used. The hoarse tones of the confirmed votary of Bacchus are due to chronic inflammation of the lining membrane of the larynx: the originally smooth surface being roughened and thickened by the irritation of alcohol, the vocal cords have less freedom of movement, and their vibrations are blurred, or rather muffled, by the unevenness of their contiguous edges.

In discussing the speaking voice, its compass, mechanism, and defects are fully considered. The various diseases of the larynx, paralysis, and abnormal growths are not overlooked, and a special chapter treats of the training of the voice for speaking in public. The importance of early training is dwelt upon, and the improvement which is possible to a poor voice by proper methods of culture.

In concluding the volume, Dr. Mackenzie de-

sires it to be understood that he speaks as a physician, rather than as a singing-master or an elocutionist, and that his aim is to furnish the vocalist and public speaker with a guide to the diseases of the voice, and the best means of avoiding them. He has accomplished his object in a manner which is no surprise to those who know his skill and acquirements.

RECENT EARTHQUAKE LITERATURE.

Report on the East Anglian earthquake of April 22, 1884.

By R. MELDOLA and WILLIAM WHITE. London, 1885.

THE Essex field-club of England has devoted vol. i. of its 'Special memoirs' to the Essex earthquake of April 22, 1884, which has already been the subject of sundry articles in scientific periodicals and society transactions. This publication is much the most extended discussion of the phenomena which has appeared, and its authors have here given us an excellent example of the thorough presentation and discussion of the facts observed. It forms a volume of two hundred and twenty-three pages, with four maps and numerous illustrations in the text. It begins by giving a list of nearly sixty previous British earthquakes which had caused structural damage, the records being drawn from various sources, and including some that are not mentioned in Mallet's 'British association catalogue.'

After describing the careful methods of collecting and sifting the data in regard to the present shock, some twenty pages are devoted to its general character. It is regarded as the most serious seismic disturbance that has affected Great Britain for four centuries, extended over fully five thousand square miles, and in intensity is estimated as about one-twentieth of the great Lisbon earthquake of 1755. Pages 44 to 155 are given up to a detailed description of the phenomena at various places, the accounts being in many cases in the original language of the reporter, and in many more giving the result of personal examination of the localities, immediately after the occurrence, by the authors themselves or by competent persons authorized by them. No one who has not himself engaged in similar work can understand the labor involved in the collection and arrangement of the materials here presented. They are accompanied by numerous wood-cuts illustrating the damage done to particular buildings, and the general impression produced by their perusal is that the shock was much more severe and destructive than the accounts published at the time had led us to suppose. Many instances are given of buildings so wrecked as to be uninhabitable, and in some towns the injured buildings are numbered by

hundreds. The whole number of buildings damaged was estimated between twelve hundred and thirteen hundred, including twenty churches and eleven chapels. The area of structural damage was confined to fifty or sixty square miles in north-east Essex, having its main axis in a direction north-east and south-west from Wivenhoe to Peldon.

In considering the connection of the shock with surface geology, the chief damage is found to have been upon the London clay; but some evidence was found that the shock was spread widely, especially toward the north and north-west, by the better conducting older rocks which lie underneath. The excessive damage at Wivenhoe, as well as its comparatively sudden decrease to the north-east of that place, is attributed to reflection of the earth-wave at that place by the valley of the Colne River.

Attempts to estimate the velocity of propagation, the exact location of the centrum, etc., are admitted by the authors to be of little value as to results, owing to the uncertainty of the data available in a country where earthquakes are rare, and therefore find no one prepared for careful observation, and where also seismographs are practically unknown; but they furnish further evidence of the care with which this report has been prepared.

Alphabetical catalogue of the earthquakes recorded as having occurred in Europe and adjacent countries. By J. P. O'REILLY. Dublin, 1886.

The second memoir named above forms a part of vol. xxviii. of the Transactions of the Royal Irish academy. It is arranged on the same plan as the similar catalogue of British earthquakes published in 1884, by the same author, and which forms an earlier part of the same volume of Transactions. The present list is based mainly upon those of Mallet, Perrey, and Fuchs, and aims to give, for each of the localities arranged in alphabetical order, the number of recorded earthquake shocks, with their dates and condensed indications of the extent of the area affected. It forms a volume of two hundred and twenty quarto pages.

As it is very difficult, even where all the facts are known, to make any numerical estimate of intensity (and, moreover, for the vast majority of recorded shocks no sufficient details are now available on which to base such estimate), the element of intensity has been omitted in preparing this list, and it represents only the number of recorded earthquakes, the unit adopted being the shock. When several or many or continuous shocks are recorded, these are interpreted as meaning two or three or four shocks,—estimates which are certainly usually within the truth. It is also recog-

nized that in the earlier centuries many earthquakes must have passed entirely unrecorded, and that the list is necessarily in so far an incomplete record of the true number of earthquakes that have occurred.

In Professor O'Reilly's former memoir concerning British earthquakes, an earthquake map of the islands was presented. The present list is not accompanied by a corresponding map of Europe, the preparation of which will necessarily involve considerable time and trouble, and which, we hope and expect, will in due time appear. In these days when the graphical representation of all physical phenomena has become so common, it is certainly an important advance in seismology to be able to apply the same methods to the study of earthquake frequency in various parts of the world; and we anticipate the day when a similar map of the United States may be available for American seismologists. Indeed, some progress has already been made by the present writer in the preparation of such a map.

Statistik der erdbeben von 1865-85. Von C. W. C. FUCHS. Vienna, 1886.

Dr. Fuchs's memoir is from the ninety-second volume (1885) of the *Sitzungsberichte* of the Vienna academy. In it he has collected the records of earthquakes from his various annual reports, and arranged them according to countries; so that the statistics for any particular locality for the whole twenty years are now easily available to the student. It forms another chapter in the general earthquake catalogue which Mallet brought down to 1843, and which Perrey continued for the later years. It would be a desirable thing if Perrey's lists for the years from 1843 to 1865, which are scattered in numerous separate memoirs, could be collected and collated in a similar way. In order that the lists for different countries may be comparable one with another, Dr. Fuchs has included in his present lists only those shocks which were sensible without instruments; that is, those which correspond to the numbers III to X in the Rossi-Foré scale. The lists proper occupy about four hundred octavo pages, and are preceded by a brief separate notice of the more important earthquakes. It would have increased somewhat the usefulness of Dr. Fuchs's book if he had added an index of the countries; but, as they are arranged geographically, the deficiency is not a serious one.

Transactions of the Seismological society of Japan. Vol. ix. part 1. Tokio, 1886.

Vol. ix. of the Transactions of the Japanese society opens with a paper occupying twenty-three pages, by Dr. C. G. Knott, on earthquake frequency. After a discussion of the probable length of any

periodicity which might be due to the gravitational action of the sun or moon, with the result that the periods most likely to be discoverable are semi-annual and annual, he gives a method of combining the monthly numbers so as to eliminate any shorter periods. The author then applies these methods to Mallet's list of European earthquakes, to New Zealand earthquakes (1869-79), to the East Indian Archipelago (1873-81), to Chili earthquakes (1873-81), and to the Grecian Archipelago (1859-73). The resulting numbers are plotted in two sets of curves; the one showing the annual period, the other the semi-annual period if there be one. The curves, excepting that for the East Indies, show clear indication of a semi-annual period, but the author finds reason to doubt whether it is to be attributed to the gravitational cause which suggested the search for it. In considering the possible effect of atmospheric changes, it is suggested that earthquakes, frequently at least, are not local phenomena, and their causes may be sought at a considerable distance from the place where they occur; as, for instance, changes of pressure over the continent of Asia or over the Pacific Ocean might cause variations in the strains along the littoral line between them, and so might be a determining cause of earthquakes in the Japanese area. Pursuing this idea, Dr. Knott finds a possible or probable cause of the winter earthquake maximum (which his annual curves show in both the northern and southern regions) in the accumulations of snow over continental areas and in the annual change of barometric gradients.

The remainder of part i. is occupied by Prof. R. Shida, with two papers, entitled 'Automatic current recorder,' and 'On earth-currents.' In the former he has described and figured an instrument for automatically recording the strength and direction of a varying electric current. In the latter he has collected a brief account of what has been done in the way of observing earth-currents, adding observations of his own which seem to indicate, that, while the magnetic declination and earth-currents vary in a similar way, the latter changes are not the cause of the former, inasmuch as an increase of western declination corresponds to an increase of current flowing from north to south along a telegraph-wire, not to a decrease, as should be the case if the connection were causal. The author also discusses the possible connection of earth-currents with earthquakes.

Transactions of the Seismological society of Japan. Vol. ix. part 2. Yokohama, 1886.

The second part of this vol. ix., separately bound, is entirely occupied by John Milne with an account of the volcanoes of Japan, mainly historical and descriptive. The author gives a list of over forty

works which have been consulted in its preparation, of which twenty-six are in Japanese, a considerable proportion being in manuscript. The information thus gathered from previous writers is supplemented by extended personal observations by the author in frequent journeys made for the purpose during his residence for a dozen years or more in Japan; and it is these accounts of his own explorations that the ordinary reader will find most interesting. Among them may be especially mentioned his visit to Oshima (p. 78 ff.), where he had an opportunity of looking down into the open crater of an active volcano, which was at the time belching forth masses of molten lava to a height far above the point where he stood. It must certainly have been, as he says, 'a sight of extraordinary grandeur.' A map is given on which are marked 129 mountains of volcanic origin, 23 being in the Kurile Islands. Of these, 51 are active, 16 being in the Kuriles, and 11 in Yezo. Of the whole number, 39 are symmetrically formed cones, showing a more or less close approximation to the theoretical outline deduced by Milne in the *Geological magazine*, and by Becker in the *American journal of science*, and again discussed by Milne in this paper. From several considerations the author infers that the volcanoes of the Kuriles are of more recent formation than those of Japan.

This part, ii., of vol. ix., is issued from the office of the *Japan Mail* in Yokohama, instead of from Tokio as heretofore, and there is also an entire change in its outside appearance. There are numerous errors, which show that the English proof-readers in that office are not yet quite perfect. The word 'ejectamenta' has proved especially puzzling to them, being misprinted in six of the nine places where it occurs.

The Japanese Transactions of this society have reached vol. iii., which contains papers on 'Earth tremors,' by Milne; on the 'Earthquake of Oct. 15, 1884,' by Sekiya; and on 'Air-waves and sea-waves,' by Wada.

The volume recently issued in the International scientific series, on 'Earthquakes,' by John Milne, is also before us; but this article has already reached such a length, that its consideration must be postponed to another time.

C. G. ROCKWOOD, JR.

FROM *Nature* we learn that Japan has thirty-seven periodicals devoted to education; seven of these are medical, with a monthly circulation of 13,514; nine treat of sanitary matters, and two of pharmacy; twenty-nine are what might be termed popular scientific journals, and have a circulation of 70,000.